Effect of Localizer Radiography Projection on Organ Dose at Chest CT with Automatic Tube Current Modulation

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Abstract: Purpose To calculate the effect of localizer radiography projections to the total radiation dose, including both the dose from localizer radiography and that from subsequent chest computed tomography (CT) with tube current modulation (TCM). Materials and Methods An anthropomorphic phantom was scanned with 192-section CT without and with differently sized breast attachments. Chest CT with TCM was performed after one localizer radiographic examination with anteroposterior (AP) or posteroanterior (PA) projections. Dose distributions were obtained by means of Monte Carlo simulations based on acquired CT data. For Monte Carlo simulations of localizer radiography, the tube position was fixed at 0° and 180°; for chest CT, a spiral trajectory with TCM was used. The effect of tube start angles on dose distribution was investigated with Monte Carlo simulations by using TCM curves with fixed start angles (0°, 90°, and 180°). Total doses for lungs, heart, and breast were calculated as the sum of the dose from localizer radiography and CT. Image noise was defined as the standard deviation of attenuation measured in 14 circular regions of interest. The Wilcoxon signed rank test, paired t test, and Friedman analysis of variance were conducted to evaluate differences in noise, TCM curves, and organ doses, respectively. Results Organ doses from localizer radiography were lower when using a PA instead of an AP projection ($P = .005$). The use of a PA projection resulted in higher TCM values for chest CT ($P < .001$) owing to the higher attenuation ($P < .001$) and thus resulted in higher total organ doses for all investigated phantoms and protocols ($P < .001$). Noise in CT images was lower with PA localizer radiography than with AP localizer radiography ($P = .03$). The use of an AP projection allowed for total dose reductions of 16%, 15%, and 12% for lungs, breast, and heart, respectively. Differences in organ doses were not related to tube start angles ($P = .17$). Conclusion The total organ doses are higher when using PA projection localizer radiography owing to higher TCM values, whereas the organ doses from PA localizer radiography alone are lower. Thus, PA localizer radiography should be used in combination with reduced reference tube current at subsequent chest CT. (©) RSNA, 2016 Online supplemental material is available for this article.

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Effect of Localizer Radiography Projection on Organ Dose at Chest CT with Automatic Tube Current Modulation[1]

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Purpose: To calculate the effect of localizer radiography projections to the total radiation dose, including both the dose from localizer radiography and that from subsequent chest computed tomography (CT) with tube current modulation (TCM).

Materials and Methods: An anthropomorphic phantom was scanned with 192-section CT without and with differently sized breast attachments. Chest CT with TCM was performed after one localizer radiographic examination with anteroposterior (AP) or posteroanterior (PA) projections. Dose distributions were obtained by means of Monte Carlo simulations based on acquired CT data. For Monte Carlo simulations of localizer radiography, the tube position was fixed at 0° and 180°; for chest CT, a spiral trajectory with TCM was used. The effect of tube start angles on dose distribution was investigated with Monte Carlo simulations by using TCM curves with fixed start angles (0°, 90°, and 180°). Total doses for lungs, heart, and breast were calculated as the sum of the dose from localizer radiography and CT. Image noise was defined as the standard deviation of attenuation measured in 14 circular regions of interest. The Wilcoxon signed rank test, paired *t* test, and Friedman analysis of variance were conducted to evaluate differences in noise, TCM curves, and organ doses, respectively.

Results: Organ doses from localizer radiography were lower when using a PA instead of an AP projection (P = .005). The use of a PA projection resulted in higher TCM values for chest CT ($P < .001$) owing to the higher attenuation ($P < .001$) and thus resulted in higher total organ doses for all investigated phantoms and protocols ($P < .001$). Noise in CT images was lower with PA localizer radiography than with AP localizer radiography (P = .03). The use of an AP projection allowed for total dose reductions of 16%, 15%, and 12% for lungs, breast, and heart, respectively. Differences in organ doses were not related to tube start angles (P = .17).

Conclusion: The total organ doses are higher when using PA projection localizer radiography owing to higher TCM values, whereas the organ doses from PA localizer radiography alone are lower. Thus, PA localizer radiography should be used in combination with reduced reference tube current at subsequent chest CT.

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Tube current modulation (TCM) represents a major technique for lowering and optimizing the radiation dose of computed tomographic (CT) examinations, resulting in up to 60% dose reduction while maintaining a constant image quality (1–3). Currently, two distinct techniques for TCM are available: angular (α) modulation and longitudinal (z) modulation (3). The combination of angular and z-axis modulation techniques is routinely used for automatic exposure control in most chest, abdomen, and pelvis CT examinations (4).

Some studies have shown that the radiation dose of localizer radiography contributes considerably to the total dose of the respective CT examination, depending on the body region imaged and the projection angle of localizer radiography (5–7). O'Daniel et al (6) evaluated the radiation dose of localizer radiography for several CT manufacturers and reported that the radiation dose can be reduced significantly by using a posteroanterior (PA) instead of an anteroposterior (AP) projection. Schmidt et al (7) performed measurements in anthropomorphic male and female phantoms and similarly showed that the lowest effective doses can be obtained when using a PA projection for localizer radiography.

Interestingly, the projection used with localizer radiography has an effect not only on the radiation dose of localizer radiography itself, but also on the TCM function and, hence, the radiation dose of the subsequent CT examination. Some studies suggested that the use of a PA instead of an AP projection for localizer radiography may lead to higher tube currents and, thus, to an increased radiation dose at the CT examination (8,9). However, these studies estimated radiation doses from the CT examination only and did not take into account the dose from localizer radiography as well. In addition, the studies used the volume CT dose index automatically generated by the scanner, without calculating organ doses, the latter being more accurate and more relevant for determining potential stochastic risks and deterministic effects from ionizing radiation (10).

The purpose of this study was to calculate the effect of localizer radiograph projections to the total radiation dose, including both the dose from localizer radiography and that from subsequent chest CT with TCM.

Advances in Knowledge

- The organ doses to the breast and heart from localizer radiography performed with an anteroposterior (AP) projection are higher than those from posteroanterior (PA) localizer radiography, whereas the total dose to these organs, including both components from localizer radiography and subsequent CT, are significantly lower when using AP instead of PA localizer radiography ($P < .001$).
- Differences in organ doses from subsequent CT examinations based on opposite (PA vs AP) localizer radiography projections are the result of a higher attenuation when using PA projection localizer radiography ($P < .001$), resulting in higher tube current when using automatic tube current modulation ($P < .001$).

Implication for Patient Care

- To reduce the total dose to the breast in chest CT examinations with tube current modulation, localizer radiography should be performed with a PA projection with a reduced reference tube current at subsequent chest CT.

Materials and Methods

Phantom

An anthropomorphic Rando-Alderson phantom (The Phantom Laboratory, Salem, NY) representing a standard, adult male (height, 175 cm; body weight, 73.5 kg) was used. To investigate the effect of localizer radiograph projection on both male and female patients, we used water-filled bags attached to the phantom and fixed with a brassiere to mimic female breasts. Two different breast sizes (volume, 400 mL and 1000 mL) were used.

CT Image Acquisition and Data Reconstruction

All measurements were performed with a 192-section dual-source CT scanner (Somatom Force; Siemens Healthcare, Erlangen, Germany) operated in the single-source mode. The phantom was fixed on the couch and carefully adjusted to place the geometric center of the phantom in the center of the rotating gantry. For this, lateral localizer radiography was performed to obtain a side view for adjusting the table height, with the aim of placing the phantom in the vertical center as recently shown (11). CT scans were obtained in the craniocaudal direction from the apex of the lungs to the diaphragm with the following protocol parameters: pitch, 1.2; collimation, 0.6 × 96 mm with use of the z-flying focal spot; and gantry rotation time, 0.5 second.

All CT images were reconstructed with advanced modeled iterative reconstruction (ADMIRE3, Siemens Healthcare) by using a section thickness of 2 mm, increment of 1.6 mm, and medium smooth convolution kernel (Br36). The reconstructed field of view was 470 mm, and the image matrix was

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Abbreviations:
AP = anteroposterior
CI = confidence interval
PA = posteroanterior
TCM = tube current modulation

Author contributions:
Guarantors of integrity of entire study, N.S., H.A.; study concepts/study design or data acquisition or data analysis/interpretation, all authors; manuscript drafting or manuscript revision for important intellectual content, all authors; manuscript final version approval, all authors; agrees to ensure any questions related to the work are appropriately resolved, all authors; literature research, N.S., H.A.; clinical studies, N.S.; experimental studies, all authors; statistical analysis, N.S., H.A.; and manuscript editing, all authors

Conflicts of interest are listed at the end of this article.

Figure 1

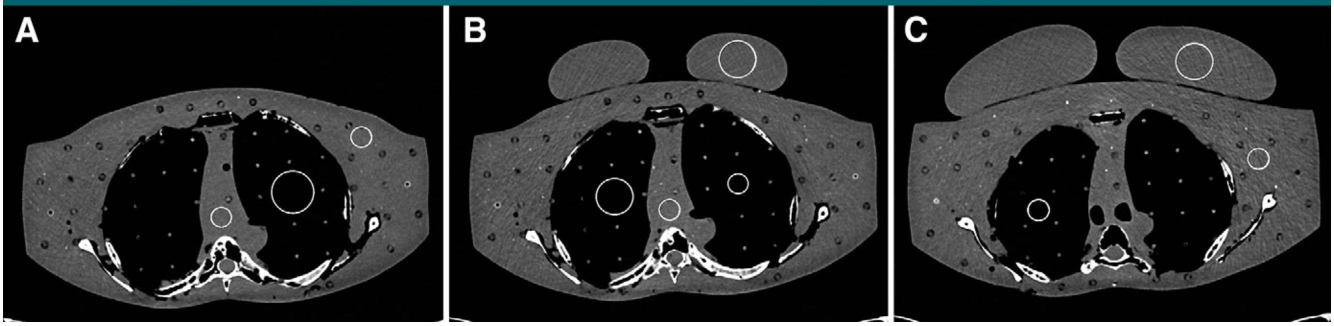

Figure 1: Transverse CT images of, *A*, anthropomorphic male phantom and, *B, C*, female phantoms with 400-mL breasts *(B)* and 1000-mL breasts *(C)* with representative 20- and 40-mm-diameter circular regions of interest.

512 × 512 pixels. Scans were obtained with tube voltages of 100 kVp and 120 kVp and quality reference tube current-time products of 100 mAs and 70 mAs, respectively, which represent our institutional default chest CT protocol parameters. TCM (CAREDose4D, Siemens Healthcare) was switched on.

Before each CT examination, single localizer radiographs with AP or PA tube angular position were acquired at a tube voltage of 80 kVp and tube current–time product of 20 mAs, which is the institutional default setting for chest CT. In total, 18 CT examinations for the three phantom types, two voltage settings, and two different localizer radiography projections were performed.

Image Quality Analysis

Image quality was analyzed by one reader (H.A., with 15 years of experience in radiology) who measured the image noise, defined as standard deviation of attenuation, in various regions of the phantoms. Nine circular regions of interest with fixed diameters of 20 and 40 mm were placed in homogeneous regions of the chest wall, mediastinum, and lungs of the phantoms (Fig 1). In the female phantoms, five additional 40-mm-diameter regions of interest were placed in the middle of the breast (Fig 1, *B* and *C*).

Localizer Radiography–based Attenuation

One of the authors (A.K.) involved in estimation of localizer radiography–based attenuation is an employee of Siemens Healthcare. The authors who are not employees or consultants of Siemens Healthcare (N.S. and H.A.) had full control over the data at all time points of the study.

In case of a single localizer radiograph, the elliptical asymmetry of the patient can be expressed as an oval ratio at a given z-axis position, and both the lateral and AP attenuation can be estimated (3). We estimated the lateral and AP attenuation of the initial beam along the z-axis based on single localizer radiograph projection data and evaluated the lateral and AP water-equivalent diameters of the phantom. The effective water-equivalent diameter (D_w) was calculated as follows (12):

$$D_w^{\mathrm{LR}} = \sqrt{D_{\mathrm{ap}}^{\mathrm{LR}} \times D_{\mathrm{lat}}^{\mathrm{LR}}},$$

where D_w^{LR} is the effective water-equivalent diameter calculated from one specific type of localizer radiograph (AP vs PA), and $D_{\mathrm{ap}}^{\mathrm{LR}}$ and $D_{\mathrm{lat}}^{\mathrm{LR}}$ are AP and lateral water-equivalent diameters, respectively, estimated from this localizer radiograph.

Radiation Dose Simulations

Three-dimensional radiation dose distributions were obtained by using a commercially available and validated Monte Carlo tool (ImpactMC; CT Imaging, Erlangen, Germany) (13). All simulations were performed by a medical physicist (N.S., with 3 years of experience in Monte Carlo methods) by using the specific scanner geometry, filtration, collimation, tube current, and tube voltage as used for the CT examinations. The CT images of the phantoms acquired with the CT scanner were used as an input volume for Monte Carlo simulations. Attenuation values (in Hounsfield units) were defined and assigned to one of the following materials: air, lung, soft tissue, and bone.

First, we simulated the three-dimensional radiation dose distributions for localizer radiography by using a fixed angular tube position at 180° and 0° for PA and AP localizer radiography, respectively (Fig 2, *A* and *B*). Tube current values per projection were calculated as follows:

$$\mathrm{mAs} = \mathrm{mA} \times \left[\frac{\text{Beam collimation}}{\text{Table speed}}\right],$$

where localizer radiography beam collimation width and table speed were extracted from the Digital Imaging and Communications in Medicine header.

To simulate the three-dimensional dose distribution for CT examinations (Fig 2, *C* and *D*), a spiral trajectory with a pitch of 1.2 and collimation of 96 × 0.6 mm was applied. Tube angular start and end positions of the exposure together with the individual TCM (α, z) curves were extracted from the raw data by using a manufacturer-provided tool.

Organ Doses

For both of the three-dimensional dose distributions (ie, localizer radiography and chest CT), volumes of interest for lungs, heart, and breasts were overlaid and the organ doses calculated as the

Figure 2

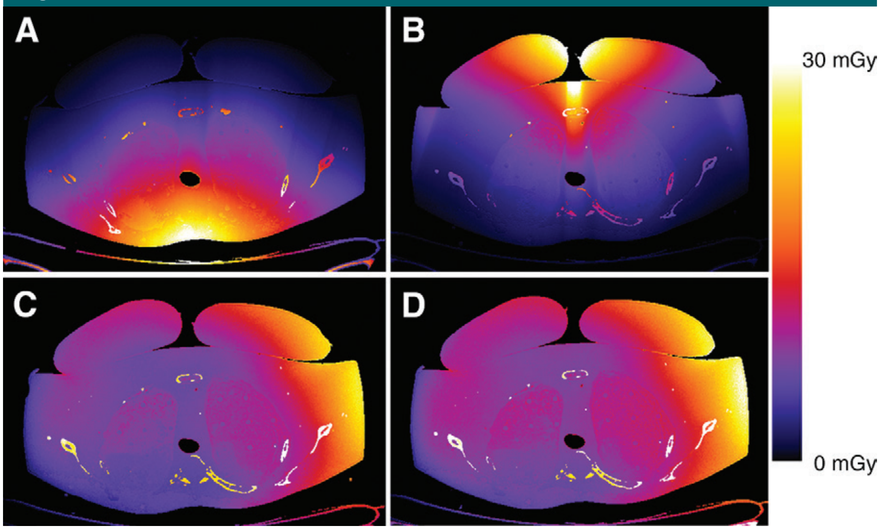

Figure 2: Transverse sections of Monte Carlo–simulated dose distributions for phantom with 1000-mL breasts with, *A*, PA localizer radiography, *B*, AP localizer radiography, and, *C, D*, chest CT with TCM with use of AP *(C)* and PA *(D)* localizer radiography.

total dose to an organ divided by the size of that organ. Total organ doses were calculated as the sum of the organ doses obtained from localizer radiography and chest CT. The difference between total organ doses from chest CT (ΔD) according to different localizer radiograph projections was calculated as follows:

$$\Delta D = \frac{[D_{\mathrm{PA}}^{N} - D_{\mathrm{AP}}^{N}]}{D_{\mathrm{PA}}^{N}},$$

where D_{PA}^{N} and D_{AP}^{N} were total doses for organ N, calculated for chest CT examinations performed with PA and AP localizer radiography, respectively.

Effect of Tube Start Angle

To evaluate the effect of tube start angles on dose distribution and organ doses, we generated tube current profiles starting at the fixed gantry angles (0°, 90°, and 180°) for CT examinations performed with AP and PA localizer radiography in addition to the TCM curves extracted from the raw data mentioned earlier. These tube current curves were based on the attenuation data from a single localizer radiographic examination and the assumption of an elliptical phantom geometry. These tube current profiles with fixed tube start angles (0°, 90°, and 180°) were used for an additional set of Monte Carlo simulations, calculating organ doses from CT examinations with one of the localizer radiograph projections, and to determine organ dose differences as described earlier.

Statistical Analysis

All statistical analyses were performed by using commercially available software (SPSS, release 22.0; SPSS, Chicago, Ill). The Wilcoxon signed rank test was used to evaluate pairwise differences in image noise among the CT data on the basis of different localizer radiograph projections. The difference between water-equivalent diameters estimated from opposite (PA vs AP) localizer radiograph projections was evaluated by using a paired t test for each phantom type. The paired t test was also used to determine differences in TCM curves obtained from the opposite localizer radiograph projections and differences in total organ doses. The Friedman analysis of variance was used to compare the differences in organ doses between CT examinations with TCM curves with the three start angles 0°, 90°, and 180°. Two-tailed $P < .05$ was considered to indicate a statistically significant difference. We also calculated the 95% confidence interval (CI).

Results

Localizer Radiography–based Attenuation and TCM Curves

The water-equivalent diameters calculated from localizer radiography with both AP and PA projections are shown in Figure 3. On average, the water-equivalent diameter estimated from PA localizer radiography was larger than that estimated from AP localizer radiography ($P < .001$ [95% CI: 0.71, 0.92], $P < .001$ [95% CI: 0.04, 0.44], and $P < .001$ [95% CI: 0.17, 0.82] for the male phantom and the female phantoms with 400-mL and 1000-mL breasts, respectively). Because the TCM algorithm is designed to compensate for varying x-ray attenuation, the increase in phantom size estimated from the PA versus AP projection leads to a higher tube current. Figure 4 demonstrates the TCM curves and the average tube current per projection over the entire CT scan volume according to the localizer radiograph projection angle for CT examinations with a tube voltage of 100 kVp. The average tube current was higher with the PA projection than with the AP projection for all scans ($P < .001$ [95% CI: 69.76, 74.65], $P < .001$ [95% CI: 41.92, 49.34], and $P < .001$ [95% CI: 31.98, 39.30] for the male phantom and the female phantoms with 400-mL and 100-mL breasts, respectively).

Organ Doses

Doses for the lungs, heart, and breast from localizer radiography, chest CT, and both localizer radiography and chest CT with TCM are shown in the Table.

Localizer radiography dose.—The organ doses from localizer radiography alone ranged from 0.01 to 0.09 mGy, depending on phantom type and projection angle. For the heart and breast, which are located more in the anterior aspect

Figure 3

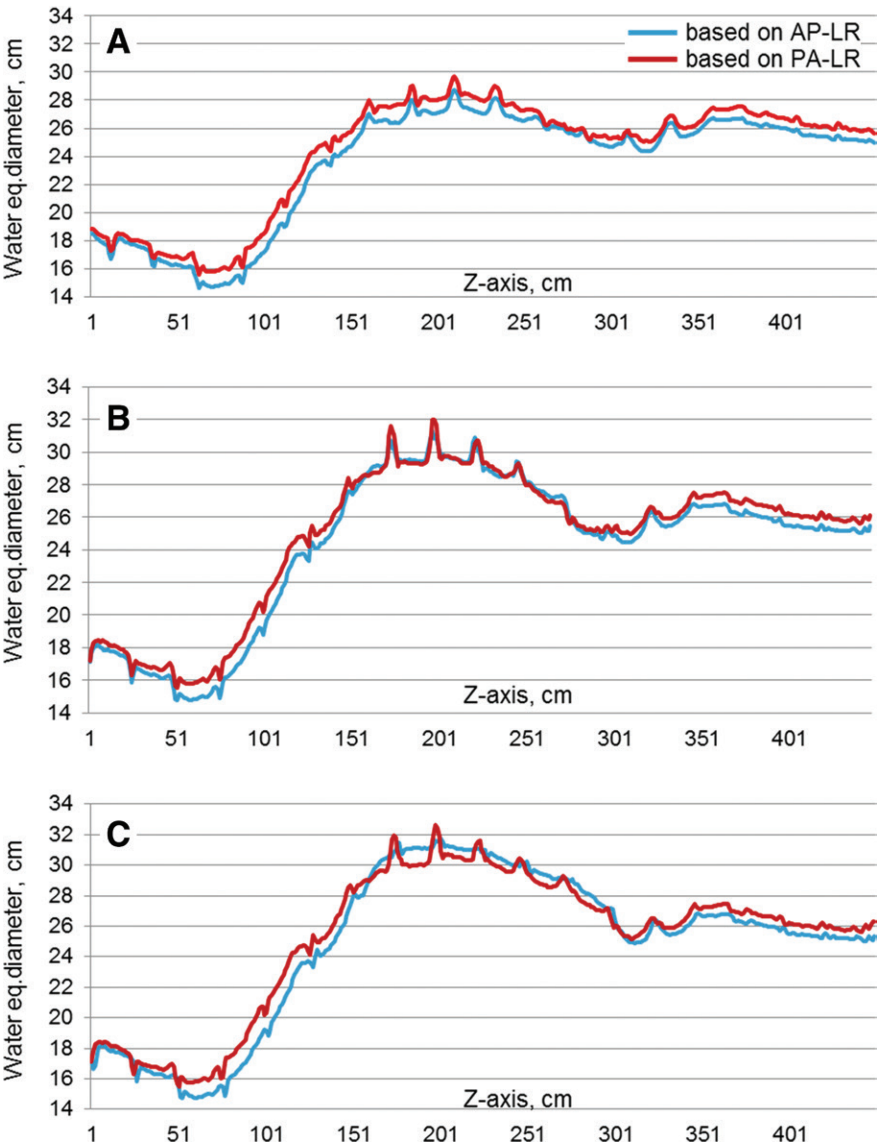

Figure 3: Graphs show water-equivalent *(eq)* diameters estimated from AP and PA localizer radiography *(LR)* for, *A*, male phantom and, *B, C*, female phantoms with 400-mL breasts *(B)* and 1000-mL breasts *(C)*.

of the chest, the doses from AP localizer radiography were higher than those with the PA projection (P = .005; 95% CI: 0.02, 0.07), whereas the dose to the lungs was similar at both localizer radiograph projections (P = .184; 95% CI: −0.21, 0.007).

CT dose.—The organ doses from chest CT were two orders of magnitude higher than those from localizer radiography. For all investigated phantom types, all organ doses were lower with chest CT performed with AP projection localizer radiography compared with PA projection localizer radiography.

Total dose.—The total organ doses, defined as the sum of the doses from localizer radiography and chest CT, were lower with use of AP rather than PA localizer radiography for all investigated phantoms and all kilovolt peak and milliampere second settings (mean organ dose: 6.63 mGy ± 0.78 vs 7.40 mGy ± 0.90, respectively; P < .001 [95% CI: −0.89, −0.65]). The average organ dose reduction with AP projection localizer radiography was 14% (7.66 mGy/6.54 mGy). For all investigated phantoms, the organ doses for the lungs, heart, and breast were higher at 120 kVp and 70 quality reference mAs settings than with 100 kVp and 100 quality reference mAs settings.

Breast dose.—The absolute dose values to the breast from AP projection localizer radiography alone were higher than those with a PA projection (mean: 0.08 mGy vs 0.01 mGy, respectively) and were much lower than those from subsequent chest CT. The total dose to the breast was, on average, 15% lower (5.69 mGy/6.74 mGy) with chest CT performed with AP instead of PA localizer radiography. The maximum breast dose reduction of 18% was observed in the phantom with 400-mL breasts and chest CT with a tube voltage of 100 kVp (8.50 mGy/10.40 mGy).

To illustrate the effect of localizer radiograph projection angle on dose distribution in chest CT with TCM, the relative dose difference between CT based on PA as opposed to AP localizer radiography is shown in three dimensions in Movie 1 (online). The relative dose difference ΔD is shown for the female phantom with 400-mL breasts with the 100 kVp and 100 quality reference mAs protocol.

Image Quality

The image noise measured in the nine and 14 regions of interest in each male and female phantom, respectively, showed that the difference between those chest CT images obtained with an AP compared with a PA projection is significant (P = .03; 95% CI: −1.11, −0.61). The noise level in CT images obtained with AP projection localizer radiography was, on average, 4% higher than that in CT images obtained with PA localizer radiography.

Effect of Tube Start Angle

Organ doses for the lungs, heart, and breast, averaged over the start angles (0°, 90°, and 180°), together with

Figure 4

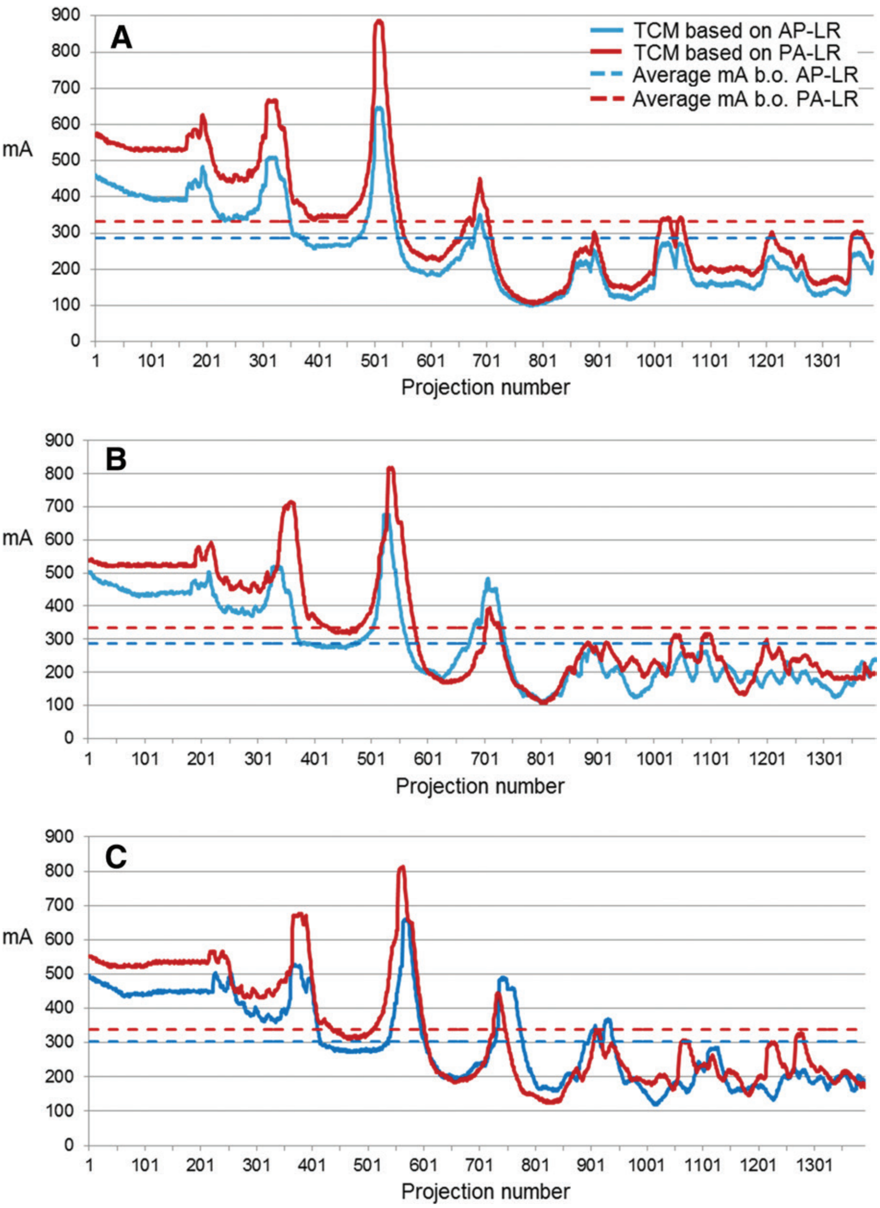

Figure 4: TCM curves and average milliampere values at chest CT performed with 100 kVp and AP and PA localizer radiography *(LR)* for, *A*, male phantom and, *B*, *C*, female phantoms with 400-mL breasts *(B)* and 1000-mL breasts *(C)*. *b.o.* = based on.

maximum and minimum values, are shown in Figure E1 (online). Doses for the lung and heart were similar for all investigated tube start angles, whereas the breast dose showed moderate variation depending on the tube start angle. Although the dose values for some organs were different depending on the tube start angle, the average doses from chest CT with PA localizer radiography were higher than those obtained with an AP projection (mean: 6.58 mGy ± 0.79 vs 7.38 mGy ± 0.91, respectively; $P < .001$ [95% CI: 0.73, 0.87]). The ΔD (difference between organ doses based on AP and PA projection of localizer radiography) was similar across the various tube start angles ($P = .17$), which indicates that the differences in organ doses were not related to the tube start angles.

Discussion

In our study, we considered the radiation dose from both localizer radiography with different projection angles and subsequent chest CT with TCM and calculated the organ doses. We found that the use of AP instead of PA localizer radiography for chest CT results in a lower radiation dose to all chest organs at all tube voltage and tube current settings. In particular, the breast dose could be reduced by up to 18% when using AP localizer radiography for chest CT. These dose differences were the result of the higher attenuation estimated by the CT scanner when localizer radiography was performed with a PA projection, leading to higher TCM values, which was also paralleled by differences in image noise.

Our study shows that the phantom attenuation estimated with a single PA projection of localizer radiography is higher than that with AP localizer radiography. To calculate both the lateral and frontal patient size from a single localizer radiographic examination data set, the patient is assumed to be elliptical in cross section (3,14). However, the natural asymmetry of each patient's anatomy leads to variations in the localizer radiography profiles performed with an AP versus PA projection and, hence, to variations in size estimations owing to geometric magnification. Because the attenuation of the x-ray beam passing through the matter is exponentially proportional to the thickness, even a small difference in D_w leads to a relevant variation in tube current and, thus, radiation dose.

Vertical centering of the patient plays an essential role in the estimation of the D_w for localizer radiography (9,15,16). Ideally, imaging should be performed with the attenuation center of the object in the isocenter. In reality, however, the center of attenuation is not necessarily coincident with the patients' visually defined middle flank. Furthermore, the center of attenuation depends

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Organ Doses for Localizer Radiography with AP and PA Projection Angles and Chest CT with TCM

Tube Voltage, Imaging Modality, and Projection	Organ Dose (mGy)		
	Lungs	Breast	Heart
Male phantom			
Localizer radiography, 80 kVp and 20 quality reference mAs			
AP	0.05		0.06
PA	0.05		0.02
CT, 100 kVp and 100 quality reference mAs			
AP	7.06		4.96
PA	8.79		6.07
Total			
AP	7.11		5.02
PA	8.84		6.09
Difference (AP vs PA) (%)	19.58		17.50
CT, 120 kVp and 70 quality reference mAs			
AP	8.05		5.88
PA	9.64		6.91
Total			
AP	8.10		5.94
PA	9.69		6.93
Difference (AP vs PA) (%)	16.42		14.23
Female phantom with 400-mL breasts			
Localizer radiography, 80 kVp and 20 quality reference mAs			
AP	0.04	0.09	0.05
PA	0.05	0.01	0.02
CT, 100 kVp and 100 quality reference mAs			
AP	7.47	8.41	5.72
PA	9.08	10.39	6.64
Total			
AP	7.51	8.50	5.77
PA	9.13	10.40	6.66
Difference (AP vs PA) (%)	17.78	18.30	13.36
CT, 120 kVp and 70 quality reference mAs			
AP	8.01	9.25	6.42
PA	9.48	11.16	7.34
Total			
AP	8.05	9.34	6.47
PA	9.53	11.17	7.36
Difference (AP vs PA) (%)	15.56	16.41	12.09
Female phantom with 1000-mL breasts			
Localizer radiography, 80 kVp and 20 quality reference mAs			
AP	0.04	0.07	0.06
PA	0.05	0.01	0.02
CT, 100 kVp and 100 quality reference mAs			
AP	8.16	7.61	5.81
PA	9.52	9.12	6.34
Total			
AP	8.20	7.68	5.87
PA	9.57	9.13	6.36
Difference (AP vs PA) (%)	14.32	15.89	7.75
CT, 120 kVp and 70 quality reference mAs			
AP	8.67	8.61	6.81
PA	9.90	9.75	7.35
Total			
AP	8.71	8.68	6.87
PA	9.95	9.76	7.37
Difference (AP vs PA) (%)	12.47	11.07	6.82

(continues)

(continued)

on the z location and therefore does not remain at the isocenter for the entire imaging range (15). Our observations indicate that, despite trying to vertically center the phantom as accurate as possible, the attenuation centering was on average too low. Similar findings according to the patient vertical centering were previously reported (9,11,17).

The study also showed that dose differences (ΔD) for the breast are higher than those for the lungs and heart. This can be explained by the fact that relative differences in tube current between examinations based on opposite localizer radiographs are not constant and fluctuate along the z-axis. Because dose differences are proportional to the differences in milliampere second, the ΔD for each organ depends on its vertical location.

The tube start angle showed no effect on lung dose in all phantoms, whereas it had a small effect on the female breast. Similar results were reported by Zhang et al (18), who showed that tube start angles are more relevant for smaller and peripheral organs than for bigger and inner ones. Nevertheless, for each of the investigated tube start angles, the organ doses were always lower with use of AP instead of PA projection localizer radiography. In addition, no significant effect of tube start angle on differences in organ dose ΔD from chest CT on the basis of different localizer radiograph projections was found. This can be explained by the fact that organs considered in this study were relatively big and their full volume was covered by at least one full rotation of the tube at the investigated collimation and pitch value. These results might differ in CT examinations of smaller organs and when using higher pitch values.

Our study has limitations. First, we did not investigate the impact on radiation dose from a combination of frontal and lateral localizer radiography. Second, we investigated the localizer radiograph projection angle only for one specific type of CT scanner from one vendor. Because TCM techniques are proprietary and unique to the different vendors, evaluation of one system's characteristics cannot be extrapolated to others. Third, we used an anthropomorphic phantom that represented a relatively thin individual and, thus, results cannot be transferred to patients with a larger body habitus. Finally, to imitate the female shape we used a male phantom with breast attachments and not a female phantom.

In summary, the results of our study indicate that the use of PA projection localizer radiography for chest CT with TCM results in higher tube current values and thus higher doses for all chest organs. Thus, we recommend for patients a protocol with PA localizer radiography with correspondingly reduced reference tube current at subsequent chest CT.

Disclosures of Conflicts of Interest: **N.S.** disclosed no relevant relationships. **A.K.** disclosed no relevant relationships. **H.A.** disclosed no relevant relationships.

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